GENERAL REMARKS

With the amendment above, Applicant has amended the claims to clearly reflect several important features of the claimed invention: that the multiplier is intended for use in computing weighted inputs in signal processing transforms based on sums of weighted inputs; that "sums of products [that] are not desired products of two numbers" according to the invention means sums of products that contain at least two different inputs with non-zero weights and that are not simply decompositions of a single product into a sum of partial products.

The Objection to the Specification - Drawings

The Office Action cited 37 CFR 1.81 specifically with respect to the independent claims (claim 1, claim 7, and claim 9), requiring drawings to facilitate understanding of the invention.

Applicant has provided Figures 3 and 4 to complement the material in the original drawings 1 and 2 and the extensive prose discussion of the invention in the specification. Applicant submits that Figure 3 facilitates understanding of machine claim 1 and method claim 9 without introducing new material. Applicant assumes familiarity with DFT definitions through well-known prior art and through discussions in the specification. Applicant submits that Figure 4 facilitates understanding of machine claim 7 in which one multiplier computes multiple desired products and feeds back intermediate results from one computation for use in another computation.

Accordingly, the Applicant requests withdrawal of the objection to the abstract of the specification.

The Objection to Informalities in the Claims

The Office Action objected to informalities in claims 8 and 16. In particular, each claim included condition statement pairs with each member indented separately. Office Action requested clarification. Applicant has added "or" at the end of the first indented condition in each pair and a semi-colon at the end of the second indented condition in each pair.

Accordingly, Applicant requests withdrawal of objections on grounds of informality to claims 8 and 16.

The Rejections of Claims Under 35 USC SS 112

Indefinite Language in Claims 2-6, 7-8, 10-11, 13-14, and 15-16

The Office Action rejected claims 2-6, 7-8, 10-11, 13-14, and 15-16 under 35 U.S.C. 112, second paragraph, "as being indefinite for failing to point out and distinctly claim the subject matter which applicant regards as the invention." The individual claims are discussed below.

Claim 2 – Use of "can" in line 3

The Applicant has removed the portion of the claim in which "can" appeared. Applicant's original intent was to list a benefit of having the first real multiplier means unable to perform the same product computation as the second real multiplier means, namely the qualitative possibility of reduced-complexity implementations of the first real multiplier means. The whereby clause in which the "can" appeared was not intended to be a statement of machine elements integral to the functioning of the invention.

Claims 3, 6, 10-11, and 14 – Similar issues of indefiniteness due to "can" in qualitative whereby clauses

The Office Actions similarly rejected claims 3, 6, 10-11, and 14 on the same grounds of having a "can" statement in a whereby clause without support in the claim or in the specification for defining what "can" means.

Applicant's original intent in each of these claims was, as with claim 2, to express a potential benefit of the invention embodiments according to the claims. The whereby clauses again listed qualitative possibilities – that reduced-cost multipliers are possible if the limitations imposed by the claims are permitted – rather than stating machine or method elements required to make the invention embodiments of the claims.

Applicant has removed the whereby clauses in claims 3, 6, 10-11, and 14.

Applicant therefore requests withdrawal of rejection under 35 USC 112 paragraph 2 to claims 2, 3, 6, 10-11, and 14.

Claim 4 – Indefiniteness due to "may be" in line 4

As with "can" in claims 2, 3, 6, 10-11, and 14, the "may be" in claim 4 is part of a whereby clause intended to express a potential benefit of an embodiment of the invention, in this case computing the first product and the second product simultaneously rather than in a serially. The possibility of parallel computation was not intended to be a distinct element or function of the embodiment according to the claim. Applicant has removed the corresponding whereby clause and requests withdrawal of the rejection.

Claims 5 and 13 – Indefiniteness issues with "may be"

The Office Action rejected claims 5 and 13 on the same grounds of a "may be" use leading to indefiniteness. Applicant's intent in each case was to express qualitative possibility in a whereby clause, not to cite elements required to make an embodiment of

the invention. Applicant has removed the whereby clauses and requests withdrawal of the rejection of claims 5 and 13.

Limitation issues of "second product" in claims 7 and 15

The Office Action cited claim 7, lines 8-10 "computing a second product equal to the product of first number and second number" as being indefinite and stated for examination purposes the second product would be considered equal to the product of the first number and the third number. The Office Action cited the same issue for claim 15.

Applicant has amended claim 7 to properly read "second product equal to the product of said first number and said third number" as originally intended. In claim 15, the existing language "second product is equal to the product of said first number and a third number", as originally written, does not need correction.

Applicant therefore requests withdrawal of objection to claims 7 and 15 on grounds of indefiniteness.

Lack of antecedent for "the complex conjugate" in claims 8 and 16

The Office Action cited "the complex conjugate" in claim 8, lines 2-3 as lacking an antecedent basis and similarly for claim 16.

The Applicant understands the requirement of an antecedent basis to apply to declared claim elements when they are recited repeatedly. For instance, "a first blue widget" is

used the first time a first blue widget is described, while thereafter references are to "said first blue widget" or "the first blue widget", in each case referring back to the original element.

Applicant submits that "the complex conjugate" in claim 8, lines 2-3 is not a declared element of the claim. It is part of a full descriptor "the complex conjugate of said second number" which in turn is part of a relational statement that "said second product is not equal to the product of said first number and the complex conjugate of said second number". The meaning of "the complex conjugate of said second number" is mathematically well-defined and unique in terms of "said second number" in any complex number coordinate system such as Cartesian or polar. "Said second number" is a claim element with a proper antecedent which is the "second number" in claim 7 line 5.

Another way of thinking about it is that there are not, for instance, "a first complex conjugate of said second number" and "a second complex conjugate of said second number" which contribute to the claim as different elements, say, as two different inputs to some later stage, so "the complex conjugate" does not refer to multiple complex conjugates. Alternatively, the relational construct "said second product is not equal to the product of said first number and the complex conjugate of said second number" is analogous to, say "said product X is not equal to the product of said Y and said Z". Where X, Y, and Z have appropriate antecedent, "the product" is not a separate claim element but a well-defined function relating X, Y, and Z.

Applicant submits that in claim 8, lines 2-3, "said second number" has a proper antecedent which is the "second number" in claim 7 line 5 and that "the complex conjugate of said second number" is well-defined in terms of this antecedent.

Similarly, Applicant submits that "the complex conjugate of said third number" in claim 8, lines 4-5 is well-defined in terms of the antecedent "third number", that "the complex conjugate of said first number" in claim 8, line 8 is well-defined in terms of the antecedent "first number".

For claim 16, Applicant submits that "the complex conjugate of said second number" on lines 2-3 is well-defined in terms of the antecedent "second number" from claim 15, that "the complex conjugate of said third number" on lines 4-5 is well-defined in terms of the antecedent "third number" from claim 15, and that "the complex conjugate of said first number" on line 8 is well-defined in terms of the antecedent "first number" from claim 15.

Applicant requests withdrawal of objection to claims 8 and 16 on grounds of "the complex conjugate" limitations lacking antecedent. Applicant submits that "the complex conjugate" as used is not a separate element of each claim but instead is part of a relational function comparing values of separate elements of each claim.

Claim Rejections Under 35 U.S.C. 102

The Office Action rejected claims 1-16 under 35 U.S.C. 102(b) as anticipated by U.S. Patent 6,223,197 issued to K. Kosugi.

U.S. Patent 6,223,197 is entitled CONSTANT MULTIPLIER, METHOD AND DEVICE FOR AUTOMATICALLY PROVIDING CONSTANT MULTIPLIER AND STORAGE MEDIUM STORING CONSTANT MULTIPLIER AUTOMATIC PROVIDING PROGRAM and was discussed by the Applicant in the Information Disclosure Statement letter included with the original application. The discussion indicated that Kosugi's patent was related to constant multiplication – in other words, of one number by another number which is a fixed, known constant – illustrated multiplication in binary number formats, and proposed methods for automating design of constant multipliers for use in EDA (Electronic Design Automation) software used for laying out, verifying, and testing of integrated circuits.

The Office Action particularly cited Figure 2, 3, and 4 of Kosugi as anticipating machine claims 1 through 8 of the present application and also as anticipating the corresponding method claims 9 through 16.

Claim 1 – Kosugi Figure 2 shows computation of a <u>single product</u> as a sum of partial products

Figure 2 of Kosugi shows a constant multiplier for multiplying a number "A" by a constant "59", with a decomposition into the sum "59 x A = 64 x A – (4 x A + 1 x A)". The products "64 x A" and "4 x A" are partial products, while "1 x A" is nominally a partial

product but doesn't require any computation, only presentation of A. The title of Figure 2 provided by Kosugi is the following:

> FIG. 2 is a constitutional view showing a modified example of the constant multiplier of the embodiment of the present invention.

This indicates Kosugi's intent that the system depicted in the figure is a constant multiplier, with one variable input "A" and one variable output which is always "59 x A".

Claim 1 of the present application begins with the following language:

> A machine used in computing one or more sums of products wherein at least one of said sums of products is not a desired product of two numbers

Applicant's intent was that the present invention apply to signal processing transforms such as Discrete Fourier Transforms that compute weighted sums of inputs – in other words, that take input numbers, multiply them by weights to get products, and combine the products into sums. See, for instance, page 3 lines 1-5 of the original application, equation (1) on page 13, and extensive related discussion. Applicant did not intend that the invention apply to decomposition of a single product into a sum of partial products, and to emphasize this restricted the invention to computing "one or more sums of products wherein at least one of said sums is not a desired product of two numbers". See, for instance, the paragraph of page 22 encompassing lines 8-16.

Applicant submits that in Figure 2 of Kosugi there are two "sums of products".. One sum of products, the output of block 5, is the sum of the partial product "A x 4" and the nominal partial product "A x 1". Applicant submits that this output is in fact a desired product "5 x A" of two numbers, "5" and "A". The product "5 x A" is itself a partial product of the overall desired product "59 x A".

The other sum of products depicted in the figure is the output of block 10'. The inputs to block 10' are "A x 64", the complement of "A x 5", and "1". The latter two inputs combine to contribute "(-5) x A" to the block 10' output when the numbers are in two's complement format. Overall, the output of block 10' is "59 x A". Applicant submits that this is in fact a desired product "59 x A" of two numbers, "59" and "A".

Applicant submits that Figure 2 of Kosugi is a basic example of breaking down computation of a single product into a sum of partial products, with each partial product being a product of one number ("A") and a partial component of the other number (factors adding up to "59"). It happens that the partial products each involve a low-cost multiplication (as discussed by the Applicant in the original application) such as shifting to implement multiplication by a power of two.

Overall, the Kosugi patent is targeted at automatic generation of efficient individual constant multiplier circuits by decomposing product computation into a minimal set of steps including shifting, negation, and addition. Applicant does not find mention in the claims or specification of Kosugi of computing two or more separate products jointly, only computation of a single product broken down into a sum of partial products. A key feature of the present invention is joint computation of separate products.

Consider computation of the product "A x B" for two numbers "A" and "B". "A x B" is a "desired product of two numbers". Let A = A1 + A2, and let B = B1 + B2. Clearly "A x B" is equal to "(A1 + A2) x (B1 + B2)", which can be computed as the sum of four partial products, "(A1 x B1) + (A1 x B2) + (A2 x B1) + (A2 x B2)". Obviously, it's possible to compute "A x B" without ever computing a product of "A" or a product of "B", and in

general there are an uncountable infinity of possible decompositions of the product "A x B" into a sum of partial products of A, B, or other numbers.

Moreover, in terms of A1, B1, A2, and B2, the sum of products "(A1 x B1) + (A2 x B2) + (A2 x B1) + (A2 x B2)" might be interpreted as "a sum of products that is not a desired product of two numbers", but only if there are no known special relationships among A1, B1, A2, and B2. As there are special relationships, and the desired product is "(A x B)", the sum <u>should not</u> be interpreted as "a sum of products that is not a desired product of two numbers".

To clarify the original intent and the differences between the present invention and the work of Kosugi and other prior art, Applicant has amended claim 1 to expressly indicate that a "sum of products [that] is not a desired product of two numbers" is "not a decomposition of a single product into a sum of partial products". Further, Applicant has added a claim element clarifying that at least one of the computed products contributes to a sum of products that is not a desired product of two numbers.

Applicant therefore submits that claim 1 is not anticipated by Kosugi Figure 2 because the invention embodied by Kosugi Figure 2 is a decomposition of a single product computation into a sum of partial products, while the invention embodied by claim 1 of the present application involves a joint product computation with results that contribute to a sum of products that is not a decomposition of a single product.

Applicant has similarly amended independent claims 7 and 9.

In Figure 3, Kosugi discloses "a constant multiplier automatic providing device". This is a block diagram of a system for generating constant multipliers such as that depicted in Figure 2 of Kosugi. In Figure 4, Kosugi discloses a flowchart for providing a constant multiplier through the steps of producing partial products, adding the partial products at intermediate stages, and adding results at a final stage.

Kosugi Figure 2-4 and Present Claims 1-16

Applicant submits that rejection of claims 1-16 of the present invention as anticipated by Kosugi Figure 2-4 rests solely on interpretation of the meaning of "a sum of products [which] is not a desired product of two numbers". The Office Action proposed an interpretation that any sum of products can be considered not a desired product of two numbers. Applicant clarified with the present amendments and reference to his original discussion that the interpretation should be that "a sum of products is not a desired product of two numbers" implies that it is not a decomposition of a single product of two numbers into a sum of partial products, which was Applicant's original intent.

Applicant therefore submits that the amended claims of the present invention are not anticipated by Kosugi Figures 2-4 or by the claims and specification of the Kosugi patent, and therefore requests withdrawal of rejections to claims 1-16 under 35 USC 102 with respect to Kosugi.

Comments on Prior Art Made of Record and Not Relied Upon

The Office Action included a list of 3 additional U.S. Patents made of record and not relied upon, which were U.S. Patent 5,831,883, U.S. Patent 5,841,684, and U.S. Patent 5,930,160. Below Applicant includes a summary of these prior references and some comments on the differences between the prior art and the preset invention.

Comments on U.S. Patent 5,831,883 Issued to Suter and Stevens

U.S. Patent 5,831,883 entitled LOW ENERGY CONSUMPTION, HIGH PEROFRMANCE FAST FOURIER TRANSFORM and issued to B. Suter and K. Stevens on November 3, 1998 discusses fast structures for discrete Fourier transform (DFT) computation and relates them to integrated circuit cost models, particularly dynamic power dissipation (when circuits are changing) and static power dissipation (essentially zero in CMOS IC technologies). The FFT approach of breaking an N-point DFT into computation of N1 N2-point DFTs, multiplication by twiddle factors (a term widely used in the prior art), and then computation of N2 N1-point DFTs, where N1 x N2 = N, is well-known in the prior art, as are the computational advantages of 4-point and 8-point FFT butterflies.

The main contributions of U.S. Patent 5,831,883 are proposal of local storage of intermediate results in computing N1-point and N2-point DFTs rather than global storage which is potentially far away from the calculation circuits and proposal of data manipulation only when necessary. The first contribution reduces the energy required to transport data over long distances, while the latter reduces energy otherwise used for unnecessary computations or for repeated storage of data that doesn't change.

While the patent does include a logic gate and block diagrams of multiplier circuits (e.g. Figure 3), the focus is on complex number multiplication, for which various structures are also well-known from the prior art.

Comments on U.S. Patent 5,841,864 Issued to Dockser

Applicant has discussed U.S. Patent 5,841,864 entitled METHOD AND APPARATUS FOR COMPUTER IMPLEMENTED CONSTANT MULTIPLICATION WITH MULTIPLIERS HAVING REPEATED PATTERNS INCLUDING SHIFTING OF REPLICAS AND PATTERNS HAVING A LEAST TWO DIGIT POSITIONS WITH NON-ZERO VALUES and issued to K.A. Dockser on November 24, 1998 previously in the Information Disclosure Statement letter filed with the original application.

As a redux, Dockser's invention covers constant multipliers which break computation of single products of two numbers down into sums of partial products. As with Kosugi's work discussed above, partial products are generated, then shifted (a low-cost operation that implements multiplication by a power-of-two) and added together.

Comments on U.S. Patent 5,930,160 Issued to Mahant-Shetti

U.S. Patent 5,930,160 entitled MULTIPY ACCUMULATE UNIT FOR PROCESSING A SIGNAL AND METHOD OF OPERATION and issued to S.S. Mahant-Shetti on July 27, 1999 describes a decomposition of a single product computation into a sum of partial products. The main approach is similar to those of Dockser and Kosugi, with the added twist of splitting input numbers into groups of bits similar to the A = A1 + A2, B = B1 + B2

decomposition discussed earlier in conjunction with computing “A x B” as “(A1 x B1) + (A1 x B2) + (A2 x B1) + (A2 x B2)”.

Applicant submits that the present invention differs considerably from the prior art made of record but not relied upon.

Conclusion

For all the above reasons, the Applicant submits that the specification and the claims are now in proper form, and that the claims are all patentable over the prior art. Therefore, the Applicant submits that this application is now in condition for allowance, which action is respectfully solicited.

Conditional Request for Constructive Assistance

The Applicant has amended the specification and claims of this application so that they are proper, definite, and define novel structure which is also unobvious. If, for any reason this application is not believed to be in full condition for allowance, the Applicant, <u>an independent inventor and pro se filer</u>, respectfully requests the constructive assistance and suggestions of the Examiner pursuant to M.P.E.P SS 2173.02 and SS 707.07(j) in order that the undersigned can place this application in allowable condition as soon as possible and without the need for further proceedings.

Very Respectfully,

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December 21, 2004 Charles Douglas Murphy

Charles Douglas Murphy, Applicant